ER 38 - Electrician Regulations
Answer Schedule

Notes:1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. Symbols and terms - alternatives

Power	W or P
Voltage	V or E or U
Phase	Active

Question 1	*Marks*	*Reference*	*Marking notes*
(a) (i) Any ONE of:	(1 mark)		
• The owner of the fittings or The occupier of the premises		ER 40(2)	
• The person who commissioned the work or The occupier of the premises		ESR 68(1)	
(ii) 3 years	(1 mark)	ER 40(4) ESR 68(2)	
(b) 218.5V	(2 marks)	ER 53(3)(b) ESR 59(4)	
(c) ANY ONE of:	(2 marks)		
• Warrant of Electrical Fitness		ER97(4)	
• Certificate of Compliance.		ER97(4)	
• Warrant of Electrical Fitness		ESR 77(1)	
(d) Any ONE of from AS/NZS 3000::	(2 marks)	(2 marks)	
• Other circuits including submains and final subcircuits supplying fixed or stationary equipment		2000 1.7.4.3.4(b)	
• Other circuits including submains and final subcircuits supplying fixed or stationary equipment		2007 1.5.5.3(d)	

Question 1	*Marks*	*Reference*	*Marking notes*
• Other circuits where is can be shown that people are not subjected to touch voltages that exceed safe values.		2007 5.7.2(b)	
(e) (i) Any ONE of from AS/NZS 3000::	(1 mark)		
• It must be outside or not above any zone		2000: 2.9.8.4(e)	
• It must be outside any classified zone		2007: 2.9.2.5(e)	
(ii) Any ONE of from AS/NZS 3000::	(1 mark)		
• It must be suitably protected from the effects of the operation of the sprinkler system which may affect their operation.		2000: 2.9.8.4(h)	
• It must have a degree of protection of IPX4		2007: 2.9.2.5 (j)	
(f) The current carrying capacity of the neutral shall not be less than that of the largest associated active conductor.	(2 marks)	AS/NZS 3000: 2000: 3.5.2(b)(i)(A) 2007: 3.5.2(b)(iv)	
(g) Any TWO of: • The low voltage cables are of a type providing the equivalent of double insulation; or • All cables or each conductor of a multicore cable are insulated for the highest voltage present; or • The low voltage cables are installed in a separate compartment of a common cable trunking system and the compartment has fixed and continuous barriers.	(2 marks)	AS/NZS 3000: 2000: 3.9.9.3 2007: 3.9.8.3	
(h) Any ONE of from AS/NZS 3000::	(2 marks)		

Question 1			Marks	Reference	Marking notes
	●	Where live parts of electrical equipment or unsheathed cables might come in contact with such metalwork.		2000: 5.7.3.7	
	●	…. shall be earthed by the connection of a protective earthing conductor to the — (B) Metallic framework or electrical equipment support structure which is in effective electrical contact with the exposed conductive part.		2000: 5.6.7.5.2 (c) (i)(B)	
	●	Where the risk of contact with live parts of electrical equipment or insulated, unsheathed cables exist.		2007: 5.4.6.1	
	●	Where the double insulation of cables in contact with structural metalwork is not permanently and effectively maintained.		2007: 5.4.6.1	
(i)	(i)	(1) Separated extra-low voltage (SELV) (2) Protected extra-low voltage (PELV)	(1 mark)	AS/NZS 3000: 2000: 7.7.2 2007: 7.5.2	
	(ii)	PELV	(1 mark)	AS/NZS 3000: 2000: 7.7.3 2007: 7.5.6	
(j)	(i)	2.7 metres for insulated conductors or 4.0 metres for uninsulated conductors	(1 mark)	ECP 34 Table 4	
	(ii)	5.5 metres	(1 mark)	ECP 34 Table 4	

Question 2	*Marks*	*Reference*	*Marking notes*
(a) (i) • Correctly drawn Zone 0 of the shower	(½ mark)	AS/NZS 3000 2000 figs 7.1A (e) & 7.1C (a) 2007 figs 6.7 & 6.10	
• Correctly drawn Zone 1 of the shower	(½ mark)	AS/NZS 3000 2000 figs 7.1A (e) & 7.1C (a) 2007 figs 6.7 & 6.10	
• Correctly drawn Zone 2 of the shower	(½ mark)	AS/NZS 3000 2000 figs 7.1A (e) & 7.1C (a) 2007 figs 6.7 & 6.10	
• Correctly drawn Zone 3 of the shower	(½ mark)	AS/NZS 3000 2000 figs 7.1A (e) & 7.1C (a) 2007 figs 6.7 & 6.10	
(ii) • Correctly drawn Zone 0 of the basin	(½ mark)	AS/NZS 3000 2000 figs 7.1A (e) & 7.1C (a) 2007 figs 6.7 & 6.10	
• Correctly drawn Zone 2 of the basin	(½ mark)	AS/NZS 3000 2000 figs 7.1A (e) & 7.1C (a) 2007 figs 6.7 & 6.10	
(b) (i) • The figure has to show the light switch: * In Zone 2 of the shower. or * In Zone 3 of the shower.	(½ mark)	AS/NZS 3000: 2000: Figure 7.1A(e) 2007: Figure 6.7	No marks can be awarded for part (b) if the switch is placed: • In Zone 0 or Zone 1
• Being accessible when entering the ensuite.	(½ mark)	(½ mark)	• On or in any part of the

Question 2	*Marks*	*Reference*	*Marking notes*
(ii) For the answer given in (b)(i) either: ● Zone 2 - The switch must be rated IPX 4 ● Zone 3 - No IP rating required	(½ mark)	AS/NZS 3000: 2000: 7.1.4.1(b) 2007: 6.2.4.1(b)	
(iii) The switch must be at least 0.3m above the floor.	(½ mark)	AS/NZS 3000: 2000: 7.1.4.3 2007: 6.2.4.3	
(c) (i) The figure has to show the towel rail and permanent connection unit in: ● In Zone 2 of the shower. or ● In Zone 3 of the shower.	(1 mark)	AS/NZS 3000: 2000: Figure 7.1A(e) 2007: Figure 6.7	No marks can be awarded for part (c) if the towel rail of PCU is placed: ● In Zone 0 or Zone 1 ● On or in any part of the hatched area.
(ii) For the answer given in (c)(i) either: ● Zone 2 The towel rail and permanent connection unit must be rated IPX 4 ● Zone 3 No IP rating required	(½ mark)	AS/NZS 3000: 2000: 7.1.4.1(b) 2007: 6.2.4.1(b)	
(d) (i) The figure has to show the room heater and wall switch in: ● In Zone 2 of the shower. or ● In Zone 3 of the shower.	(1 mark)	AS/NZS 3000: 2000: Figure 7.1A(e) 2007: Figure 6.7	No marks can be awarded for part (d) if the heater or switch is placed: ● In Zone 0 or Zone 1 ● On or in any part of the hatched area.
(ii) For the answer given in (c)(i) either: ● Zone 2 The room heater and wall switch must be rated IPX 4 ● Zone 3 No IP rating required	(½ mark)	AS/NZS 3000: 2000: 7.1.4.1(b) 2007: 6.2.4.1(b)	

Question 2	*Marks*	*Reference*	*Marking notes*
(e) (i) The figure has to show the socket outlet in: • In Zone 3 of the shower or • Outside Zone 2 of the basin.	(½ mark)	AS/NZS 3000: 2000: Figure 7.1A(e) 2007: Figure 6.7 & 6.10	No marks can be awarded for part (e) if the socket outlet is placed: • In Zone 0 or Zone 1 • On or in any part of the hatched area.
(ii) For the answer given in (d)(i) either: • Zone 3 – no IP rating required or • Outside Zone 2 of the hand basin - no IP rating required	(½ mark)	AS/NZS 3000: 2000: 7.1.4.1(b) 2007: 6.2.4.1(b)	
(iii) RCD protected or supplied from an isolated supply	(1 mark)	AS/NZS 3000: 2000: 7.1.4.2(c) 2007: 6.2.4.2(c)	

Question 3	*Marks*	*Reference*	*Marking notes*
(a) (i) From Table 42, single-phase conversion factor is 1.155			
Submains			
Vd = $\frac{\text{Vc x L x I x 1.155}}{1000}$	(½ mark)		
= $\frac{\text{3.86 x 25 x 40 x 1.155}}{1000}$	(½ mark)		
= 4.46V	(1 mark)		
Final subcircuit			
Vd = $\frac{\text{Vc x L x I x 1.155}}{1000}$	(½ mark)		
= $\frac{\text{28.6 x 15 x 15 x 1.155}}{1000}$	(½ mark)		
= 7.43V	(1 mark)		
Total Voltage Drop	(½ mark)		
= 1.97 + 4.46 + 7.43			
= 13.86volts	(1 mark)		
(ii) • ER 53(3) or ESR 59(4)	(½ mark)		
• Permitted voltage drop = 5% of 230 = 11.5V	(½ mark)		
• Therefore installation does not comply	(½ mark)		
(b) Increase the size of cable C to 2.5 mm^2	(½ mark)		
Vd = $\frac{\text{Vc x L x I x 1.155}}{1000}$			
= $\frac{\text{15.6 x 15 x 15 x 1.155}}{1000}$	(½ mark)		
= 4.05V	(1 mark)		
Total Voltage Drop	(½ mark)		
= 1.97 + 4.46 + 4.05			
= 10.48V	(½ mark)		

Question 4	*Marks*	*Reference*	*Marking notes*
(a) To ensure that the insulation resistance between all live conductors and earth or, as the case may be, all live parts and earth is adequate to ensure the integrity of the insulation.	(2 marks)	AS/NZS 3000: 2000: 6.3.3.3.2 2007: 8.3.6.1	
(b) (i) Insulation resistance tester	(1 mark)	AS/NZS 3000: 2000: 6.3.3.3.1 2007: 8.3.6.1	
(ii) (A) To stress the insulation at levels above the nominal operating voltage.	(½ mark)		
(B) Any ONE of: ● To ensure capacitive or inductive reactance does not influence the test result. ● A constant maximum voltage is a more stringent test than the momentary peaks of an a.c. waveform.	(½ mark)		
(c) The test method described has to show:			
● The MEN link and main neutral disconnected.	(1 mark)		
● Disconnection of the range and water heater	(1 mark)		
● All switches and circuit breakers in the “ON” position	(½ mark)		
● Testing between live parts and earth	(1 mark)		
● A minimum of 1 MΩ test value for the installation	(½ mark)		
● Testing between phase/neutral and earth of the water heater.	(½ mark)		This can include: ● Bridging the phases and neutral and testing to earth
A minimum value of 10,000Ω.	(½ mark)		
● Testing between phase/neutral and earth of the range.	(½ mark)		

Question 4	*Marks*	*Reference*	*Marking notes*
A minimum value of 10,000Ω.	(½ mark)		

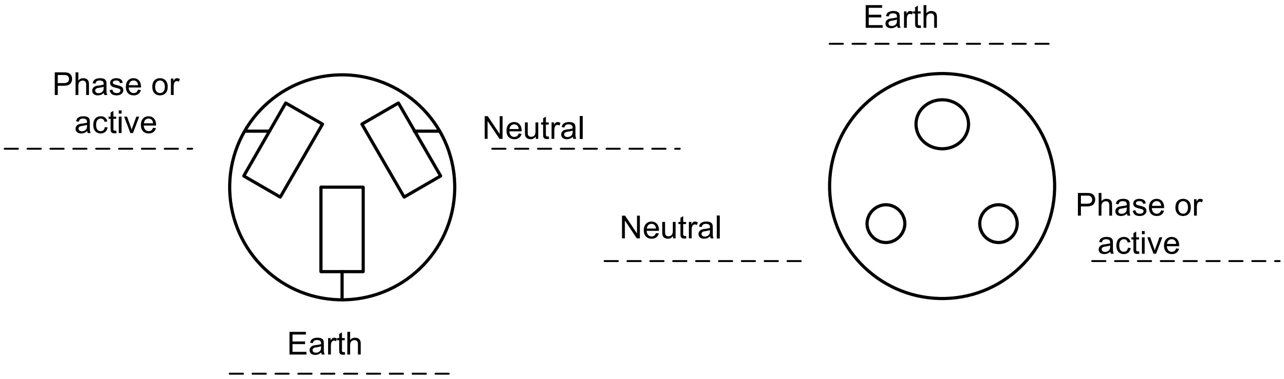
Question 5			*Marks*	*Reference*	*Marking notes*
(a)	(i)	Any FOUR of: ● Fixed-wired and connected through a continuous flexible cord to a supply of electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts ● The appliances is supplied with electricity from a monitored earth circuit where the supply to the appliance is automatically disconnected if the earth to the appliance is broken or disconnected. ● The appliances are supplied with electricity through an RCD. ● The appliances are supplied with electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts.	(2 marks)	ER 77 ESR 89	No marks can be award for (a) if: ● An extra-low voltage system is selected because appliances operate at 230V. ● Double insulated appliances are selected because all appliances are Class I
	(ii)	Any TWO of the following relating to what the candidate has stated in (a)(i): ● The appliance is operating on an isolated supply which has no reference to earth hence no potential to earth. ● The earth wire continuity is continuously being monitored and will disconnect the appliance when the earth fails. ● The earth leakage current is continuously being monitored by RCD and will disconnect the appliance when earth leakage rises above a pre-determined level. ● The appliance is operating on a isolated supply which has no reference to earth hence no potential to earth	(4 marks)		

Question 5	*Marks*	*Reference*	*Marking notes*

(b) (i)

AS/NZS 3112

IEC 60309



½ mark for each label	(3 marks)		For each socket, all labels must be fully correct to gain the marks No marks are awarded for (b)(i) is either socket is incorrectly earthed.
(ii) 250V	(1 mark)	ER 77 ESR 89	

Question 6	*Marks*	*Reference*	*Marking notes*
(a) Any ONE of from AS/NZS 3000:	(2 marks)		
• The fault-loop impedance is low enough to allow sufficient current to flow in the fault loop to cause the protective device to operate within the specified disconnection time.		2000: B4.2	
• In the event of a fault between a live part and an exposed conductive part which could give rise to a prospective touch voltage exceeding 50 V a.c. or 120 V ripple-free d.c., a protective device shall automatically disconnect the supply to the circuit or electrical equipment concerned.		2000: 1.7.4.3.2	
• The characteristics of protective devices and the earthing system impedance shall be such that, if a fault of negligible impedance occurs anywhere in the electrical installation between an active conductor and a protective earthing conductor or exposed conductive part, automatic disconnection of the supply will occur within the specified time.		2000: 1.7.4.3.3	
• The maximum disconnection time for 230/240 V supply voltage shall not exceed the following: - 0.4 s for final subcircuits - 5 s for other circuits including submains and final subcircuits		2000: 1.7.4.3.4	
• The resistance from any point on the electrical installation required to be earthed to the point where the main earthing conductor is connected to the neutral conductor of the supply system shall be low enough to permit the passage of current necessary to operate the circuit protective devices.		2000: 5.4.3.	

Question 6	*Marks*	*Reference*	*Marking notes*
• In the event of a fault between a live part and an exposed conductive part which could give rise to a prospective touch voltage exceeding 50 V a.c. or 120 V ripple-free d.c., a protective device shall automatically disconnect the supply to the circuit or electrical equipment concerned.		2007: 1.5.5.3(b)	
• The characteristics of protective devices and the earthing system impedance shall be such that, if a fault of negligible impedance occurs anywhere in the electrical installation between an active conductor and a protective earthing conductor or exposed conductive part, automatic disconnection of the supply will occur within the specified time.		2007: 1.5.5.3(c)	
• The maximum disconnection time for 230/240 V supply voltage shall not exceed the following: - 0.4 s for final subcircuits - 5 s for other circuits including submains and final subcircuits		2007: 1.5.5.3(d)	
• Disconnecting the supply from a section of the installation concerned in such a way as to limit the time/touch voltage relationship to safe levels in the event of an insulation fault.		2007: 5.7.1	
(b) From the point of the fault through:			
• The protective earthing conductor	(½ mark)		
• The earth bar/ MEN link/ neutral bar	(½ mark)		
• The main neutral	(½ mark)		
• The distribution neutral	(½ mark)		
• The transformer star point	(½ mark)		
• The transformer winding	(½ mark)		
• The distribution active	(½ mark)		
• The mains active conductor	(½ mark)		
• The main switch	(½ mark)		

Question 6	Marks	Reference	Marking notes
• The protective device • The final sub-circuit active • The flexible cord active	(½ mark) (½ mark) (½ mark)		
(c) From AS/NZS 3000: • 2000: 5.5.1.2(c) The minimum size of the main earthing conductor shall be determined in accordance with Item (a) and Table 5.1 in relation to the cross-sectional area of the largest active conductor of the consumers mains. **OR** • 2007: 5.3.3.2 The minimum size of the main earthing conductor shall be determined from Table 5.1 in relation to the cross-sectional area of the largest active conductor of the consumers mains.	(½ mark) (1½ marks)		

Question 7	*Marks*	*Reference*	*Marking notes*
(a) The first MEN switchboard must be located electrically closest to the point of supply	(1 mark)	ER 52(4) ESR 27(4)	
(b) • The breaking capacity shall be not less than the prospective short-circuit current at the point of installation, • All currents caused by a short circuit occurring at any point of a circuit shall be interrupted before the temperature of the conductors reaches the admissible limit. **OR** • The breaking capacity shall be not less than the prospective short-circuit current at the point where the devices are installed. • All currents caused by a short circuit occurring at any point of a circuit shall be interrupted before the temperature of the conductors reaches the permissible limit.	(2 marks)	AS/NZS 3000: 2000: 2.4.4.3 AS/NZS 3000: 2007: 2.5.4.5	
(c) Where two or more circuit-breakers are mounted in the same row, the operating mechanism of each shall cause the circuit to open when the operating means are orientated in one general direction.	(2 marks)	AS/NZS 3000: 2000: 2.9.2.3 2007: 2.9.3.4 Amend 1	
(d) Any THREE of from AS/NZS 3000:	(1½ marks)		
• Shall not be installed within 1.2m of the ground, a floor or platform.		2000: 2.9.8.4(a)	
• Shall not be installed above open water containers or fixed or stationary cooking appliances		2000: 2.9.8.4(b)	
• Shall not be installed within the space contained by vertical planes 3 m from the centre of a shower rose and extending from the floor to the ceiling.		2000: 2.9.8.4(d)	

Question 7	*Marks*	*Reference*	*Marking notes*
• Shall not be installed within or above any zone classified for a swimming pool or spa pool.		2000: 2.9.8.4(e)	
• Shall not be installed within a sauna.		2000: 2.9.8.4(e)	
• Shall not be installed within a fire-isolated stairway, passageway or ramp.		2000: 2.9.8.4(f)	
• Shall not be installed within a cupboard containing a fire-hose reel.		2000: 2.9.8.4(g)	
• Shall not be installed within 1.2m of the ground, a floor or platform.		2007: 2.9.2.5(a)	
• Shall not be installed above open water containers or fixed or stationary cooking appliances		2007: 2.9.2.5(b)	
• Shall not be installed within or above any zone classified for a bath or shower.		2007: 2.9.2.5(d)	
• Shall not be installed within or above any zone classified for a swimming pool or spa pool.		2007: 2.9.2.5(e)	
• Shall not be installed within a sauna.		2007: 2.9.2.5(e)	
• Shall not be installed in a refrigeration room.		2007: 2.9.2.5(f)	
• Shall not be installed within a fire-isolated stairway, passageway or ramp.		2007: 2.9.2.5(h)	
• Shall not be installed within a cupboard containing a fire-hose reel.		2007: 2.9.2.5(i)	
(e) (i) • Main earthing conductor. • MEN link. • Protective earthing conductors. • Functional earthing conductors, if required. • Equipotential bonding conductors. **OR**	(2½ marks)	AS/NZS 3000: 2000: 5.6.4.1 (a) to (e)	

Question 7	*Marks*	*Reference*	*Marking notes*
● Protective earthing conductors. ● Main earthing conductor. ● MEN connection ● Equipotential bonding conductors. ● Functional earthing conductors, if required.		AS/NZS 3000: 2007: 5.3.4	
(ii) Any ONE of from AS/NZS 3000:	(1 mark)		
● The MEN link shall be a conductor complying with Clause 5.5.2 and have a cross-sectional area not less than that of the main earthing conductor.		2000: 5.6.5.2	
● The MEN link shall be a conductor complying with Clause 5.3.2 and have a cross-sectional area capable of carrying the maximum current that it may be required to carry under short circuit conditions.		2007: 5.3.5.2	
● The minimum size shall not be less than the current carrying capacity of the main neutral conductor.		2007: 5.3.5.2	

Question 8	*Marks*	*Reference*	*Marking notes*
(a) $I = \frac{P}{400 \times \sqrt{3}}$	(½ mark)		
$= \frac{20000}{400 \times \sqrt{3}}$	(½ mark)		
$= 28.87A$	(1 mark)		
The allowance for load	(½ mark)		
$= 28.87 + (28.87 \times 20\%)$			
$= 28.87 + 5.77$	(1 mark)		
$= 34.64A$			
From Table 12, column 12, current rating for a 16 mm^2 cable is 39A	(½ mark)		
The 16 mm^2 cable will satisfy the load current requirements	(1 mark)		
(b) Maximum permitted voltage drop = 400 x 1% = 4V	(½ mark)		
$mV/A.m = \frac{V_d \times 1000}{A \times m}$	(½ mark)		
$= \frac{4 \times 1000}{34.64 \times 60}$	(½ mark)		
$= 1.925$	(1 mark)		
From Table 42 a 1.925 mV/A.m relates closet to a 25 mm^2 cable	(½ mark)		
Therefore a 25 mm^2 cable will satisfy the voltage drop requirements.	(1 mark)		
Alternative solution			
From Table 42 the mV/A.m For a 16 mm^2 cable is 2.43			
$V_d = \frac{mV/A.m \times A \times m}{1000}$			
$= \frac{2.43 \times 34.64 \times 60}{1000}$			
$= 5.05V$			
$25\ mm^2 = \frac{1.54 \times 34.64 \times 60}{1000}$			
$= 3.2V$			
Therefore a 25 mm^2 cable will satisfy the voltage drop requirements.			

Question 8	*Marks*	*Reference*	*Marking notes*
(c) A 25 mm^2 copper cable will satisfy the load and voltage drop requirements	(1 mark)		

Question 9	*Marks*	*Reference*	*Marking notes*
(a)(i) Any ONE of :	(2 marks)		
• Electrical connections intended to bring exposed conductive parts or extraneous conductive parts to the same or approximately the same potential, but not intended to carry current in normal service.		AS/NZS 3000: 2000: 1.4.49 2007: 1.4.52	
• To minimize the risk associated with the occurrence of voltage differences between exposed conductive parts of electrical equipment and extraneous conductive parts.		AS/NZS 3000: 2000: 5.8.1 2007: 5.6.1	
(ii) 4mm^2	(1 mark)	AS/NZS 3000: 2000: 5.8.3.2(a) 2007: 5.6.3.2(a)	
(iii) Any ONE of from AS/NZS 3000:	(1 mark)		
• If mechanical damage is likely to occur.		2000: 5.8.3.2	
• If mechanical damage is likely to occur.		2007: 5.6.3.2	
• To reduce the fault loop impedance.		2007: 5.6.3.2	
(iv) To minimize the risk associated with different voltages appearing on the two systems.	(1 mark)	AS/NZS 3000: 2000: 5.8.2.6 2007: 5.6.2.7	
(b) (i) • Where it is separated from the live conductors by double insulation; and	(1 mark)	AS/NZS 3000: 2000: 5.7.3.1(b) 2007: 5.5.3.2(b)	
• Sheathed or covered overall with non-conductive material; and	(1 mark)	AS/NZS 3000: 2000: 5.7.3.1(b) 2007: 5.5.3.2(b)	

Question 9	*Marks*	*Reference*	*Marking notes*
- All joints to and terminations of the screen or braid are suitably separated from exposed metal and live parts.	(1 mark)	AS/NZS 3000: 2000: 5.7.3.1(b) 2007: 5.5.3.2(b)	
(ii) Any FOUR of from AS/NZS 3000:	(2 marks)		
- Festoon-type lampholders of the all-insulated type.		2000: 5.7.3.3(a)	
- Luminaires that are earthed by their attachment to screwed metallic conduit or pipe		2000: 5.7.3.3(a)	
- Luminaires installed outdoors on timber poles where the luminaires are not in an earthed situation.		2000: 5.7.3.3(a)	
- ELV lighting systems.		2000: 5.7.3.3(a)	
- Festoon-type lampholders of the all-insulated type.		2007: 5.4.3(2)	
- Luminaires that are earthed by their attachment to screwed metallic conduit or pipe		2007: 5.4.3(2)	
- Luminaires installed outdoors on a non-conductive pole where the luminaires are not in an earthed situation.		2007: 5.4.3(2)	
- ELV lighting points.		2007: 5.4.3(2)	